

## Citation /

### LASER BEAM MACHINE AND ITS METHOD

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(IPC1-7): B23K26/00; H01L21/302

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#### Abstract of JP11000773

PROBLEM TO BE SOLVED: To obtain excellent machining quality by reducing machining energy at the time of wiring pattern machining. SOLUTION: In the laser beam machine machining a wiring pattern 200b by irradiating a laser beam with a laser oscillator to the multilayer thin film 200 having the wiring pattern 200b coated with a protecting film 200a, the laser oscillator is composed of the protecting film machining laser emitting the laser beam (a) for removing the protecting film 200a and the laser oscillator having the wiring pattern machining laser emitting the laser beam (b) for machining the wiring pattern 200b.

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# PATENT ABSTRACTS OF JAPAN

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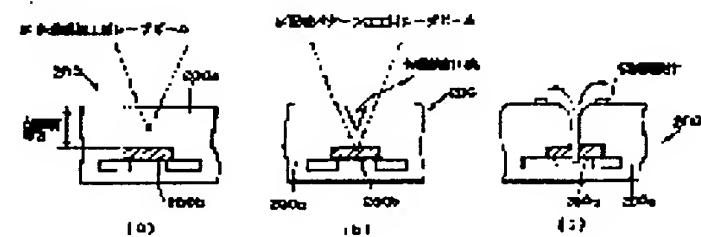
(72)Inventor : TORIGOE TOSHIHIRO

## (54) LASER BEAM MACHINE AND ITS METHOD

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To obtain excellent machining quality by reducing machining energy at the time of wiring pattern machining.

**SOLUTION:** In the laser beam machine machining a wiring pattern 200b by irradiating a laser beam with a laser oscillator to the multilayer thin film 200 having the wiring pattern 200b coated with a protecting film 200a, the laser oscillator is composed of the protecting film machining laser emitting the laser beam (a) for removing the protecting film 200a and the laser oscillator having the wiring pattern machining laser emitting the laser beam (b) for machining the wiring pattern 200b.



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**CLAIMS****[Claim(s)]**

[Claim 1] Laser-beam-machining equipment characterized by consisting of a laser oscillation machine which has the first oscillator which carries out outgoing radiation of the laser beam for removing said protective coat for said laser oscillation machine, and the second oscillator which carries out outgoing radiation of the laser beam for processing said circuit pattern in the laser-beam-machining equipment into which a laser beam is irradiated and said circuit pattern is processed with a laser oscillation vessel to the multilayered film which has the circuit pattern covered with the protective coat.

[Claim 2] Laser-beam-machining equipment according to claim 1 characterized by including the control section which controls the outgoing radiation timing of each laser beam by said first oscillator and said second oscillator.

[Claim 3] Laser-beam-machining equipment according to claim 1 or 2 characterized by installing said first oscillator and said second oscillator in the exposure side of each laser beam, and the right-angled direction.

[Claim 4] The laser-beam-machining approach characterized by including the process which removes said a part of protective coat by irradiating the laser for protective coat processing, and the process which processes said circuit pattern by irradiating the laser beam for circuit pattern processing at a degree in the exposure section by said laser beam for protective coat processing to the multilayered film which has the circuit pattern covered with the protective coat.

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**DETAILED DESCRIPTION****[Detailed Description of the Invention]****[0001]**

[Field of the Invention] This invention relates to the laser-beam-machining equipment into which the circuit pattern of the multilayered film structures, such as LSI and a photo mask, is processed (correction and cutting), and its approach.

**[0002]**

[Description of the Prior Art] Generally having exposed to a front face has few circuit patterns which have multilayered film structure, such as an LSI wafer and a photo mask, and it is covered with protective coats, such as glass material, in many cases. It consists of ingredients, such as polycrystalline silicon deposited on Si wafer, and a tungsten, aluminum, as these circuit patterns, and is processed by laser-beam-machining equipment.

[0003] A laser diode ("LD" is called hereafter.) excitation Nd:YAG laser or LD excitation Nd:YLF laser is adopted as the laser of such laser-beam-machining equipment.

[0004] The Q switch pulse train by which oscillation wavelength was the base of 1 micrometer, and it was stabilized compared with lamp excitation method laser since any [ these ] laser was excited by LD is acquired. Moreover, by using LD, prolonged maintenance is unnecessary and it has the advantage that the stable equipment operation is realizable.

[0005] In this case, cutting processing of a circuit pattern is performed by the principle shown below in order that the glass material as a protective coat may usually penetrate most laser beams of the wavelength of the base of 1 micrometer. That is, if wiring material evaporates and expands momentarily by laser condensing, the stress generated by this expansion will crush glass material, and a detailed hole will be formed in this glass material. And the wiring material evaporated through this detailed hole is emitted outside.

[0006] Under the present circumstances, in order to make effect on the lower layer section or a processing periphery into the minimum, he sets up the laser power near a processing threshold, and is trying not to irradiate the laser beam of high power superfluously.

[0007] For this reason, an improvement centering on product designs, such as optimization of a design of a protective coat, a configuration of a circuit pattern, and optimization of arrangement, is made. Moreover, in order to realize good stable processing of a processing condition, the laser-beam-machining equipment which chose the wavelength which is easy to absorb only to a wiring material is also proposed.

[0008] By the way, while the thickness of a protective coat increases in connection with multilayering and densification of LSI in recent years, it is in the inclination which circuit pattern width of face reduces.

**[0009]**

[Problem(s) to be Solved by the Invention] However, processing energy increases according to thickness increase of the protective coat as a candidate for processing, and, similarly it leads to the crushing force fall of the protective coat accompanying evaporation of wiring material required to crush a protective coat by pattern width-of-face contraction of the wiring material as a candidate for processing, and it is becoming difficult in conventional laser-beam-machining equipment to perform an energy setup from which better processing quality is acquired (to decrease the processing energy at the time of circuit pattern processing).

[0010] That is, since it is what this kind of laser beam machining depends on making the circuit pattern 102 under a protective coat 101 condense the laser beam 100 for wiring processing, and breaking through a protective coat 101 as shown in drawing 4 (a), big processing energy is needed, and processing marks become large as shown in this drawing (b) after laser beam machining. In this case, the effect on the lower

layer section or a processing periphery becomes remarkable, and processing quality deteriorates, so that a protective coat 101 becomes thick.

[0011] For this reason, the appearance of the laser-beam-machining equipment which can perform an energy setup from which processing quality better than before is acquired was demanded.

[0012] This invention aims at offer of the laser-beam-machining equipment which was made in order to meet such a request, can reduce sharply the processing energy at the time of wiring processing, can have it, and can acquire good processing quality, and its approach.

[0013]

[Means for Solving the Problem] In the laser-beam-machining equipment into which the laser-beam-machining equipment of this invention according to claim 1 irradiates a laser beam with a laser-oscillation vessel to the multilayered film which has the circuit pattern covered with the protective coat in order to attain said purpose, and a circuit pattern is processed, it has considered as the configuration which consists of a laser-oscillation machine which has the first oscillator which carries out outgoing radiation of the laser beam for removing a protective coat for a laser-oscillation machine, and the second oscillator which carries out outgoing radiation of the laser beam for processing a circuit pattern. Therefore, a part of protective coat is removed from the first oscillator by the laser beam which carries out outgoing radiation, and a circuit pattern is cut by the laser beam which carries out outgoing radiation from the second oscillator.

[0014] Invention according to claim 2 is considered as the configuration in which the control section which controls the outgoing radiation timing of each laser beam by the first oscillator and the second oscillator was included in laser-beam-machining equipment according to claim 1. Therefore, the outgoing radiation timing of the laser beam from each oscillator is controlled by the control section, and removal processing of a protective coat and cutting processing of a circuit pattern are performed one by one.

[0015] Invention according to claim 3 is considered as the configuration in which the first oscillator and the second oscillator are installed in the exposure side of each laser beam, and the right-angled direction side by side in laser-beam-machining equipment according to claim 1 or 2. Therefore, the processing location by each laser beam turns into the same location, and the amount of total displacement of each oscillator at the time of processing decreases.

[0016] The laser-beam-machining approach according to claim 4 is made into the approach in which the process which removes a part of protective coat by irradiating the laser for protective coat processing, and the process which processes a circuit pattern by irradiating the laser beam for circuit pattern processing in the exposure section by the laser beam for protective coat processing at a degree were included to the multilayered film which has the circuit pattern covered with the protective coat. Therefore, by irradiating the laser for protective coat processing, a part of protective coat is removed and a circuit pattern is cut by irradiating the laser beam for circuit pattern processing at the exposure section by the laser beam for protective coat processing.

[0017]

[Embodiment of the Invention] Hereafter, with reference to a drawing, it explains about the operation gestalt of this invention. Drawing 1 is the block diagram showing the laser-beam-machining equipment concerning the first operation gestalt of this invention. In this drawing, the laser-beam-machining equipment shown with a sign 1 is equipped with the laser 2 for protective coat processing, the first processing optical system 3, the laser 4 for circuit pattern processing, the second processing optical system 5, X-Y stage 6, the stage mechanical component 7, and a control section 8, and is installed on the stage base 9.

[0018] The laser 2 for protective coat processing (the first oscillator) consists of laser which carries out outgoing radiation of the laser beam for having the wavelength of 300nm or less and removing protective coat 200a (it illustrating to drawing 2 ) of a multilayered film 200, and is arranged above the first processing optical system 3. For example, Nd: Ultraviolet laser, such as an YAG laser (the fourth higher harmonic with a wavelength of 266nm) and excimer laser, is contained.

[0019] The first processing optical system 3 has an optical attenuator 10, the adjustable opening 11, and an objective lens 12, and is arranged in the stage base 9 through the frame 13. Thereby, laser beam a which carries out outgoing radiation from the laser 2 for protective coat processing is irradiated to the multilayered film 200 on X-Y stage 6.

[0020] The laser 4 for circuit pattern processing consists of a laser beam which carries out outgoing radiation of the laser beam for having the wavelength of 300nm - 1.1 micrometers, and processing circuit pattern 200b (it illustrating to drawing 2 ) of a multilayered film 200, and is installed in the direction of a

stage migration flat surface of the laser 2 for protective coat processing (the direction of a laser beam exposure side), and is arranged above the second processing optical system 5. For example, Nd: An YAG laser and Nd:YLF laser are contained.

[0021] The second processing optical system 5 has an optical attenuator 15, the adjustable opening 16, and an objective lens 17, and is arranged in the stage base 9 through the frame 13. Thereby, laser beam b which carries out outgoing radiation from the laser 4 for circuit pattern processing is irradiated to the multilayered film 200 on X-Y stage 6.

[0022] Each has the stage elements 6a and 6b of each other which can move in the right-angled direction, and X-Y stage 6 is arranged under the first processing optical system 3 and the second processing optical system 5, and is installed in the stage base 9. Thereby, migration actuation of the multilayered film 200 is carried out in the direction of flat-surface X-Y, and it positions to a position.

[0023] The stage mechanical component 7 is connected to the stage elements 6a and 6b of X-Y stage 6. Thereby, the stage elements 6a and 6b of X-Y stage 6 drive in the direction of flat-surface X-Y. The control section 8 is connected to the stage mechanical component 7 and both the laser 2 and 4. . by which the outgoing radiation timing of the laser beams a and b by each laser 2 and 4 is controlled by this.

[0024] Next, it explains about the laser-beam-machining approach concerning this operation gestalt using drawing 2 . Drawing 2 (a) - (c) is a sectional view shown in order to explain the laser-beam-machining approach concerning the first operation gestalt of this invention. First, the through tube (not shown) which forms crevice 200A in protective coat 200a, or results in circuit pattern 200b as a part of protective coat 200a is removed and it is shown in this drawing (b) is formed by irradiating laser beam (laser beam) a at protective coat 200a, as shown in this drawing (a).

[0025] in this case, the processing part of protective coat 200a -- several [ before the exposure of laser beam a / 1/ ] -- falling (when a crevice being formed) -- or the obstruction at the time of wiring processing by laser beam b is removed (when a through tube is formed).

[0026] Next, circuit pattern 200b is cut by irradiating laser beam b (laser beam) at the exposure section (processing section) by laser beam a, as shown in this drawing (c). In this case, laser beam b is irradiated by circuit pattern 200b through protective coat 200a, or circuit pattern 200b irradiates directly.

[0027] In addition, in this operation gestalt, although the case where each laser 2 and 4 stood in a row mutually in the direction of a stage migration flat surface was explained, this invention is not limited to this, but as shown in drawing 3 as the second operation gestalt, even when the laser 21 for protective coat processing and the laser 22 for wiring processing stand in a row mutually in a stage migration flat surface (laser beam exposure side) and the right-angled direction, it does so the same effectiveness as an operation gestalt. Setting to this drawing, signs 23 and 24 are a reflective mirror, a half mirror, and the objective lens of common use [ 25 ].

[0028] In this case, the processing location by each laser beams a and b turns into the same location, and the total stage movement magnitude at the time of processing (the amount of total displacement of each laser 21 and 22) decreases.

[0029]

[Effect of the Invention] Since it consists of a laser oscillation machine which has the first oscillator which carries out outgoing radiation of the laser beam for removing a protective coat for a laser oscillation machine, and the second oscillator which carries out outgoing radiation of the laser beam for processing a circuit pattern according to this invention as explained above, a part of protective coat is removed from the first oscillator by the laser beam which carries out outgoing radiation, and a circuit pattern is cut by the laser beam which carries out outgoing radiation from the second oscillator.

[0030] Therefore, since the processing energy at the time of wiring processing can be reduced sharply, good processing quality can be acquired.

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**TECHNICAL FIELD**

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**[Field of the Invention]** This invention relates to the laser-beam-machining equipment into which the circuit pattern of the multilayered film structures, such as LSI and a photo mask, is processed (correction and cutting), and its approach.

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**PRIOR ART**

[Description of the Prior Art] Generally having exposed to a front face has few circuit patterns which have multilayered film structure, such as an LSI wafer and a photo mask, and it is covered with protective coats, such as glass material, in many cases. It consists of ingredients, such as polycrystalline silicon deposited on Si wafer, and a tungsten, aluminum, as these circuit patterns, and is processed by laser-beam-machining equipment.

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[0004] The Q switch pulse train by which oscillation wavelength was the base of 1 micrometer, and it was stabilized compared with lamp excitation method laser since any [ these ] laser was excited by LD is acquired. Moreover, by using LD, prolonged maintenance is unnecessary and it has the advantage that the stable equipment operation is realizable.

[0005] In this case, cutting processing of a circuit pattern is performed by the principle shown below in order that the glass material as a protective coat may usually penetrate most laser beams of the wavelength of the base of 1 micrometer. That is, if wiring material evaporates and expands momentarily by laser condensing, the stress generated by this expansion will crush glass material, and a detailed hole will be formed in this glass material. And the wiring material evaporated through this detailed hole is emitted outside.

[0006] Under the present circumstances, in order to make effect on the lower layer section or a processing periphery into the minimum, he sets up the laser power near a processing threshold, and is trying not to irradiate the laser beam of high power superfluously.

[0007] For this reason, an improvement centering on product designs, such as optimization of a design of a protective coat, a configuration of a circuit pattern, and optimization of arrangement, is made. Moreover, in order to realize good stable processing of a processing condition, the laser-beam-machining equipment which chose the wavelength which is easy to absorb only to a wiring material is also proposed.

[0008] By the way, while the thickness of a protective coat increases in connection with multilayering and densification of LSI in recent years, it is in the inclination which circuit pattern width of face reduces.

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[Translation done.]

JAPANESE [JP,11-000773,A]

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CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION  
TECHNICAL PROBLEM MEANS DESCRIPTION DRAWINGS DRAWINGS

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**EFFECT OF THE INVENTION**

**[Effect of the Invention]** Since it consists of a laser oscillation machine which has the first oscillator which carries out outgoing radiation of the laser beam for removing a protective coat for a laser oscillation machine, and the second oscillator which carries out outgoing radiation of the laser beam for processing a circuit pattern according to this invention as explained above, a part of protective coat is removed from the first oscillator by the laser beam which carries out outgoing radiation, and a circuit pattern is cut by the laser beam which carries out outgoing radiation from the second oscillator.

**[0030]** Therefore, since the processing energy at the time of wiring processing can be reduced sharply, good processing quality can be acquired.

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**TECHNICAL PROBLEM**

[Problem(s) to be Solved by the Invention] However, processing energy increases according to thickness increase of the protective coat as a candidate for processing, and, similarly it leads to the crushing force fall of the protective coat accompanying evaporation of wiring material required to crush a protective coat by pattern width-of-face contraction of the wiring material as a candidate for processing, and it is becoming difficult in conventional laser-beam-machining equipment to perform an energy setup from which better processing quality is acquired (to decrease the processing energy at the time of circuit pattern processing). [0010] That is, since it is what this kind of laser beam machining depends on making the circuit pattern 102 under a protective coat 101 condense the laser beam 100 for wiring processing, and breaking through a protective coat 101 as shown in drawing 4 (a), big processing energy is needed, and processing marks become large as shown in this drawing (b) after laser beam machining. In this case, the effect on the lower layer section or a processing periphery becomes remarkable, and processing quality deteriorates, so that a protective coat 101 becomes thick.

[0011] For this reason, the appearance of the laser-beam-machining equipment which can perform an energy setup from which processing quality better than before is acquired was demanded.

[0012] This invention aims at offer of the laser-beam-machining equipment which was made in order to meet such a request, can reduce sharply the processing energy at the time of wiring processing, can have it, and can acquire good processing quality, and its approach.

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**DESCRIPTION OF DRAWINGS**

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**[Brief Description of the Drawings]**

**[Drawing 1]** It is the block diagram showing the laser-beam-machining equipment concerning the first operation gestalt of this invention.

**[Drawing 2]** (a) - (c) is a sectional view shown in order to explain the laser-beam-machining approach which similarly starts the first operation gestalt of this invention.

**[Drawing 3]** It is the block diagram showing the laser-beam-machining equipment concerning the second operation gestalt of this invention.

**[Drawing 4]** (a) And (b) is a sectional view shown in order to explain the conventional laser-beam-machining approach.

**[Description of Notations]**

1 Laser-Beam-Machining Equipment

2 Laser for Protective Coat Processing

3 First Processing Optical System

4 Laser for Circuit Pattern Processing

5 Second Processing Optical System

200 Multilayered Film

200a Protective coat

200b Circuit pattern

The laser beam for protective coat processing

b The laser beam for circuit pattern processing

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[Translation done.]

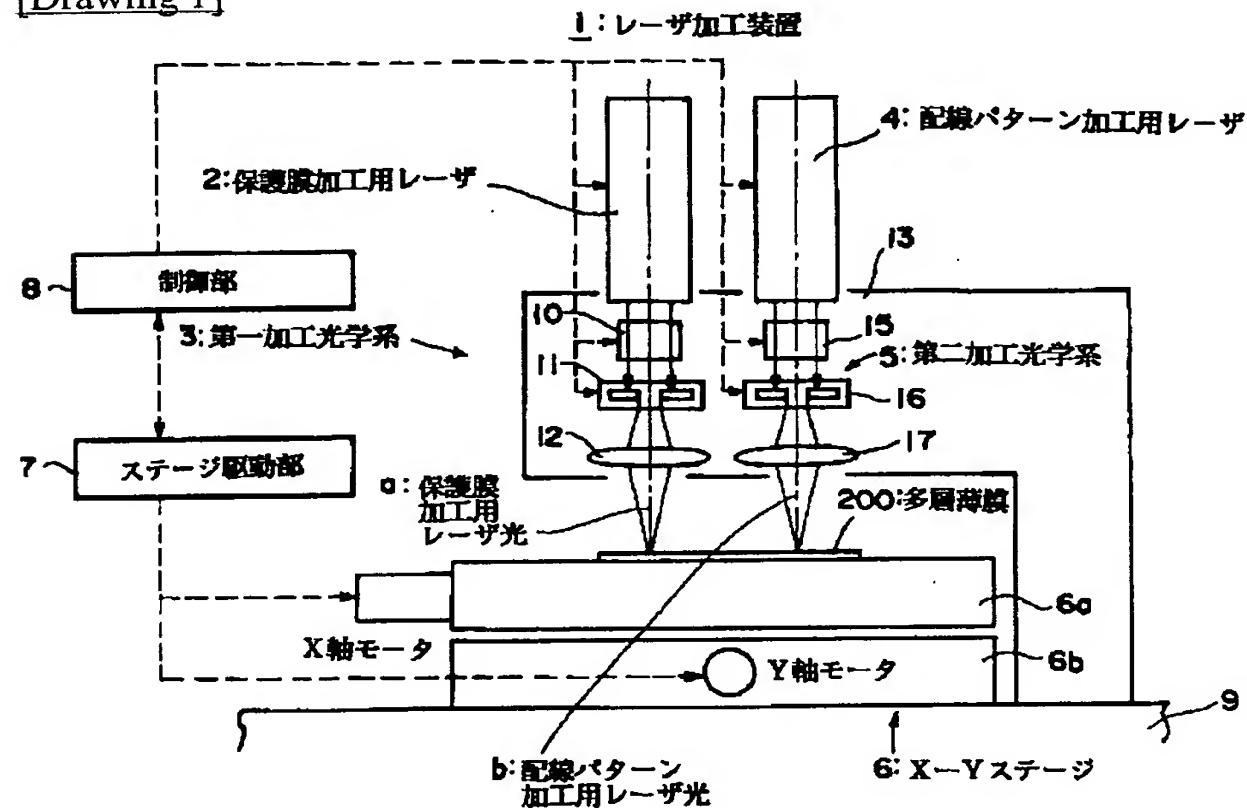
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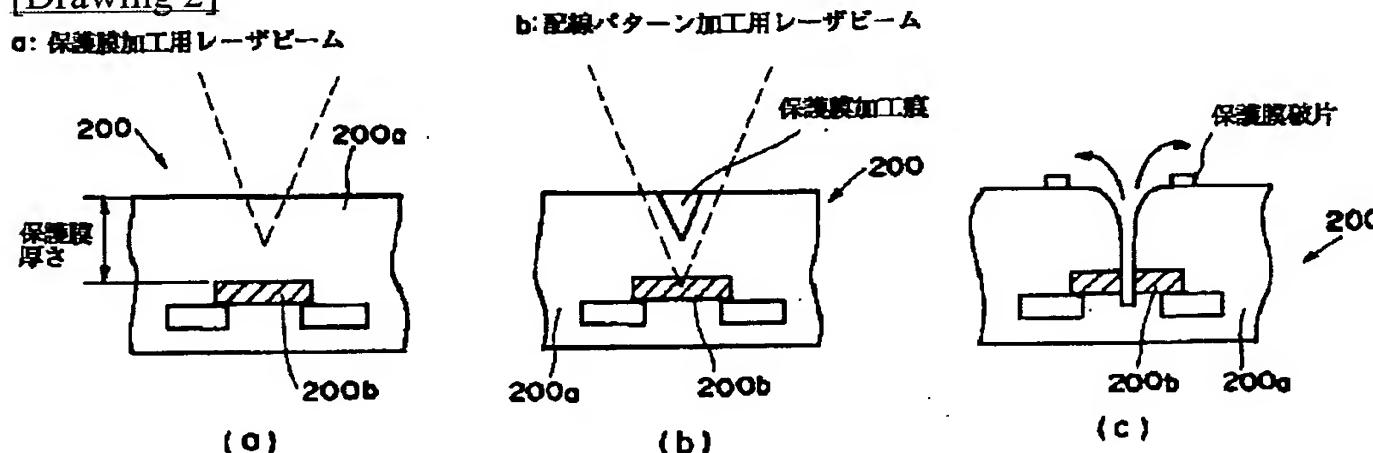
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## DRAWINGS

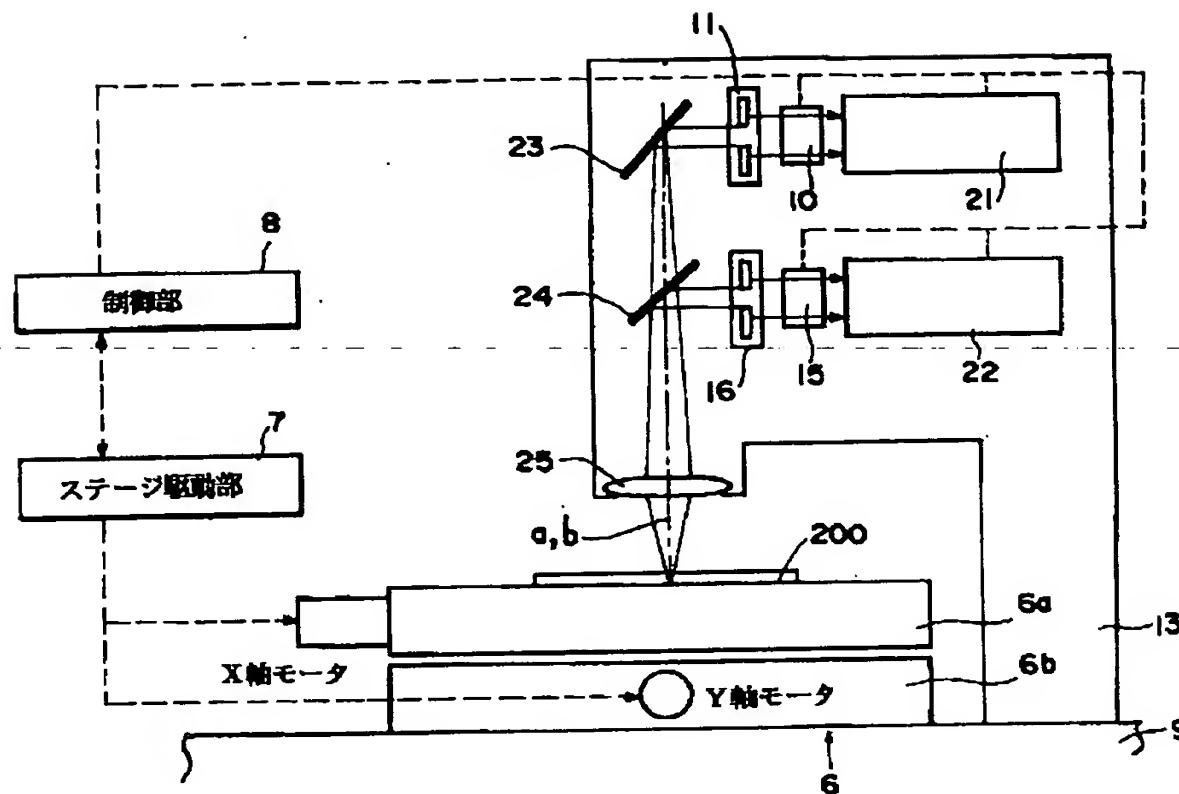
## [Drawing 1]



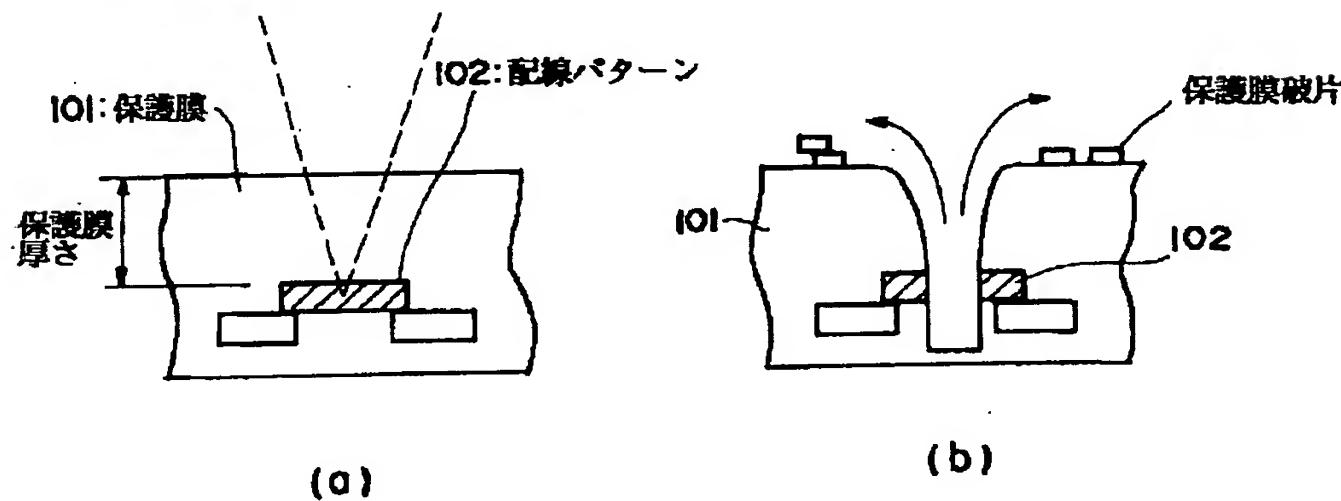
## [Drawing 2]



## [Drawing 3]



[Drawing 4]  
100: 配線加工用レーザビーム



[Translation done.]

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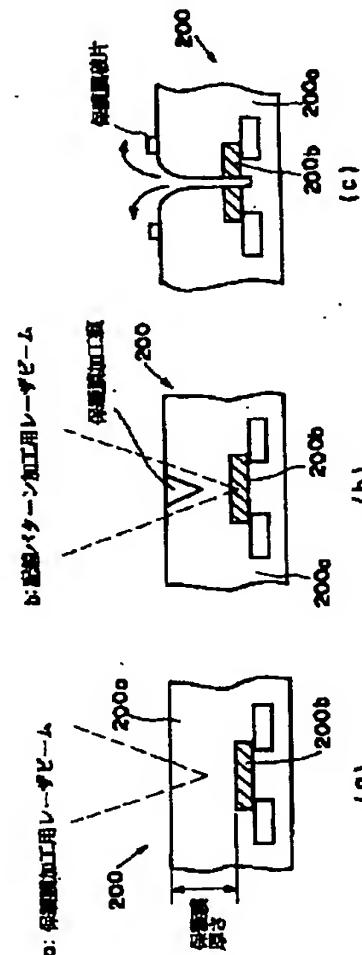
(74)代理人 弁理士 渡辺 喜平

## (54)【発明の名称】 レーザ加工装置およびその方法

## (57)【要約】

【課題】 配線加工時の加工エネルギーを低減して良好な加工品質を得る。

【解決手段】 保護膜200aによって被覆された配線パターン200bを有する多層薄膜200に対し、レーザ発振器によってレーザ光を照射し配線パターン200bを加工するレーザ加工装置において、レーザ発振器を、保護膜200aを除去するためのレーザ光aを出射する保護膜加工用レーザと、配線パターン200bを加工するためのレーザ光bを出射する配線パターン加工用レーザとを有するレーザ発振器からなる構成である。



## 【特許請求の範囲】

【請求項1】 保護膜によって被覆された配線パターンを有する多層薄膜に対し、レーザ発振器によってレーザ光を照射し前記配線パターンを加工するレーザ加工装置において、

前記レーザ発振器を、前記保護膜を除去するためのレーザ光を出射する第一発振器と、前記配線パターンを加工するためのレーザ光を出射する第二発振器とを有するレーザ発振器からなることを特徴とするレーザ加工装置。

【請求項2】 前記第一発振器および前記第二発振器による各レーザ光の出射タイミングを制御する制御部を含ませたことを特徴とする請求項1記載のレーザ加工装置。

【請求項3】 前記第一発振器および前記第二発振器が各レーザ光の照射面と直角な方向に並設されていることを特徴とする請求項1または2記載のレーザ加工装置。

【請求項4】 保護膜によって被覆された配線パターンを有する多層薄膜に対し、保護膜加工用レーザを照射することにより前記保護膜を一部除去する工程と、次に前記保護膜加工用レーザ光による照射部に配線パターン加工用レーザ光を照射することにより前記配線パターンを加工する工程とを含ませたことを特徴とするレーザ加工方法。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】 本発明は、LSIやフォトマスク等の多層薄膜構造物の配線パターンを加工（修正・切断）するレーザ加工装置およびその方法に関する。

## 【0002】

【従来の技術】 一般に、多層薄膜構造を有するLSIウエハやフォトマスク等の配線パターンは、表面に露出していることは少なく、ガラス材等の保護膜によって覆われていることが多い。これら配線パターンとしては、Siウエハ上に堆積された多結晶シリコンやタンゲステン、アルミニウム等の材料からなり、レーザ加工装置によって加工される。

【0003】 このようなレーザ加工装置のレーザには、レーザダイオード（以下、「LD」と称する。）励起Nd:YAGレーザまたはLD励起Nd:YLFレーザが採用されている。

【0004】 これらいずれのレーザも、発振波長が1μm台であり、LDで励起することから、ランプ励起方式レーザと比べて安定したQスイッチパルス列が得られる。また、LDを使うことにより、長期間保守が不要で、安定した装置稼動が実現できるという利点を有している。

【0005】 この場合、配線パターンの切断加工は、保護膜としてのガラス材が通常1μm台の波長のレーザ光を殆ど透過するため、次に示す原理により行われる。すなわち、レーザ集光によって瞬間的に配線材が気化して

膨張すると、この膨張によって発生する応力がガラス材を破碎し、このガラス材に微細な孔が形成される。そして、この微細な孔を通して気化した配線材が外部に放出される。

【0006】 この際、下層部や加工周辺部への影響を最小限にするために、加工しきい値に近いレーザパワーを設定して不必要に高いパワーのレーザ光を照射しないようしている。

【0007】 このため、保護膜の設計の最適化や配線パターンの形状や配置の最適化など製品設計を中心とした改善が行われる。また、加工状態の良好な安定した加工を実現するために、配線材料のみに吸収しやすい波長を選択したレーザ加工装置も提案されている。

【0008】 ところで、近年におけるLSIの多層化・高密度化に伴い、保護膜の厚さが増大するとともに、配線パターン幅が縮小する傾向にある。

## 【0009】

【発明が解決しようとする課題】 しかるに、従来のレーザ加工装置においては、加工対象としての保護膜の厚さ増大によって加工エネルギーが増大し、また同じく加工対象としての配線材のパターン幅縮小によって保護膜を破碎するに必要な配線材の気化に伴う保護膜の破碎力低下に繋がり、より良好な加工品質が得られるようなエネルギー設定を行うこと（配線パターン加工時の加工エネルギーを低減すること）は困難になってきている。

## 【0010】

（a）に示すように配線加工用レーザビーム100を保護膜101下の配線パターン102に集光させて保護膜101を突き破ることによるものであるため、大きな加工エネルギーを必要とし、レーザ加工後に同図（b）に示すように加工痕が大きくなる。この場合、保護膜101が厚くなる程、下層部や加工周辺部への影響が顕著になり、加工品質が悪化する。

【0011】 このため、従来より良好な加工品質が得られるようなエネルギー設定を行うことができるレーザ加工装置の出現が要望されていた。

【0012】 本発明はこのような要望に応えるべくなされたもので、配線加工時の加工エネルギーを大幅に低減することができ、もって良好な加工品質を得ることができるレーザ加工装置およびその方法の提供を目的とする。

## 【0013】

【課題を解決するための手段】 前記目的を達成するため、本発明の請求項1記載のレーザ加工装置は、保護膜によって被覆された配線パターンを有する多層薄膜に対し、レーザ発振器によってレーザ光を照射し配線パターンを加工するレーザ加工装置において、レーザ発振器を、保護膜を除去するためのレーザ光を出射する第一発振器と、配線パターンを加工するためのレーザ光を出射する第二発振器とを有するレーザ発振器からなる構成と

してある。したがって、第一発振器から出射するレーザ光によって保護膜の一部が除去され、第二発振器から出射するレーザ光によって配線パターンが切断される。

【0014】請求項2記載の発明は、請求項1記載のレーザ加工装置において、第一発振器および第二発振器による各レーザ光の出射タイミングを制御する制御部を含ませた構成としてある。したがって、制御部によって各発振器からのレーザ光の出射タイミングを制御し、保護膜の除去加工と配線パターンの切断加工が順次行われる。

【0015】請求項3記載の発明は、請求項1または2記載のレーザ加工装置において、第一発振器および第二発振器が各レーザ光の照射面と直角な方向に並設されている構成としてある。したがって、各レーザ光による加工位置が同一位置となり、加工時の各発振器の全移動量が少なくなる。

【0016】請求項4記載のレーザ加工方法は、保護膜によって被覆された配線パターンを有する多層薄膜に対し、保護膜加工用レーザを照射することにより保護膜を一部除去する工程と、次に保護膜加工用レーザ光による照射部に配線パターン加工用レーザ光を照射することにより配線パターンを加工する工程とを含ませた方法としてある。したがって、保護膜加工用レーザを照射することにより保護膜の一部が除去され、保護膜加工用レーザ光による照射部に配線パターン加工用レーザ光を照射することにより配線パターンが切断される。

【0017】

【発明の実施の形態】以下、本発明の実施形態につき、図面を参照して説明する。図1は本発明の第一実施形態に係るレーザ加工装置を示すブロック図である。同図において、符号1で示すレーザ加工装置は、保護膜加工用レーザ2と第一加工光学系3と配線パターン加工用レーザ4と第二加工光学系5とX-Yステージ6とステージ駆動部7と制御部8とを備え、ステージベース9上に設置されている。

【0018】保護膜加工用レーザ（第一発振器）2は、300nm以下の波長をもち多層薄膜200の保護膜200a（図2に図示）を除去するためのレーザ光を出射するレーザからなり、第一加工光学系3の上方に配設されている。例えばNd:YAGレーザ（波長266nmの第四高調波）やエキシマレーザ等の紫外線レーザが含まれる。

【0019】第一加工光学系3は、光減衰器10と可変開口部11と対物レンズ12とを有し、ステージベース9にフレーム13を介して配設されている。これにより、X-Yステージ6上の多層薄膜200に対し、保護膜加工用レーザ2から出射するレーザ光aが照射される。

【0020】配線パターン加工用レーザ4は、300nm～1.1μmの波長をもち多層薄膜200の配線バ

ーン200b（図2に図示）を加工するためのレーザ光を出射するレーザ光からなり、保護膜加工用レーザ2のステージ移動平面方向（レーザ光照射面方向）に並設され、かつ第二加工光学系5の上方に配設されている。例えばNd:YAGレーザやNd:YLFレーザが含まれる。

【0021】第二加工光学系5は、光減衰器15と可変開口部16と対物レンズ17とを有し、ステージベース9にフレーム13を介して配設されている。これにより、X-Yステージ6上の多層薄膜200に対し、配線パターン加工用レーザ4から出射するレーザ光bが照射される。

【0022】X-Yステージ6は、それぞれが互いに直角な方向に進退可能なステージエレメント6a, 6bを有し、第一加工光学系3および第二加工光学系5の下方に配設され、かつステージベース9に設置されている。これにより、平面X-Y方向に多層薄膜200を移動操作して所定の位置に位置決めする。

【0023】ステージ駆動部7は、X-Yステージ6のステージエレメント6a, 6bに接続されている。これにより、X-Yステージ6のステージエレメント6a, 6bが平面X-Y方向に駆動する。制御部8は、ステージ駆動部7および両レーザ2, 4に接続されている。これにより、各レーザ2, 4によるレーザ光a, bの出射タイミングが制御される。

【0024】次に、本実施形態に係るレーザ加工方法につき、図2を用いて説明する。図2（a）～（c）は本発明の第一実施形態に係るレーザ加工方法を説明するために示す断面図である。先ず、同図（a）に示すように保護膜200aにレーザ光（レーザビーム）aを照射することにより、保護膜200aの一部を除去して同図（b）に示すように保護膜200aに凹部200Aを形成するか、あるいは配線パターン200bに至る貫通孔（図示せず）を形成する。

【0025】この場合、保護膜200aの加工部分がレーザ光aの照射前の数分の一に低下する（凹部を形成した場合）か、あるいはレーザ光bによる配線加工時の障害物が除去される（貫通孔を形成した場合）。

【0026】次に、同図（c）に示すようにレーザ光aによる照射部（加工部）にレーザ光b（レーザビーム）を照射することにより、配線パターン200bを切断する。この場合、レーザ光bが保護膜200aを介して配線パターン200bに照射されるか、あるいは配線パターン200bに直接照射される。

【0027】なお、本実施形態においては、各レーザ2, 4がステージ移動平面方向に互いに並列する場合について説明したが、本発明はこれに限定されず、図3に第二実施形態として示すように保護膜加工用レーザ21および配線加工用レーザ22がステージ移動平面（レーザ光照射面）と直角な方向に互いに並列する場合でも実

施形態と同様の効果を奏する。同図において、符号23および24は反射ミラーとハーフミラー、25は共用の対物レンズである。

【0028】この場合、各レーザ光a, bによる加工位置が同一位置となり、加工時の全ステージ移動量（各レーザ21, -22の全移動量）が少なくなる。

【0029】

【発明の効果】以上説明したように本発明によれば、レーザ発振器を、保護膜を除去するためのレーザ光を出射する第一発振器と、配線パターンを加工するためのレーザ光を出射する第二発振器とを有するレーザ発振器からなるので、第一発振器から出射するレーザ光によって保護膜の一部が除去され、第二発振器から出射するレーザ光によって配線パターンが切断される。

【0030】したがって、配線加工時の加工エネルギーを大幅に低減することができるから、良好な加工品質を得ることができる。

【図面の簡単な説明】

【図1】本発明の第一実施形態に係るレーザ加工装置を

示すブロック図である。

【図2】(a)～(c)は同じく本発明の第一実施形態に係るレーザ加工方法を説明するために示す断面図である。

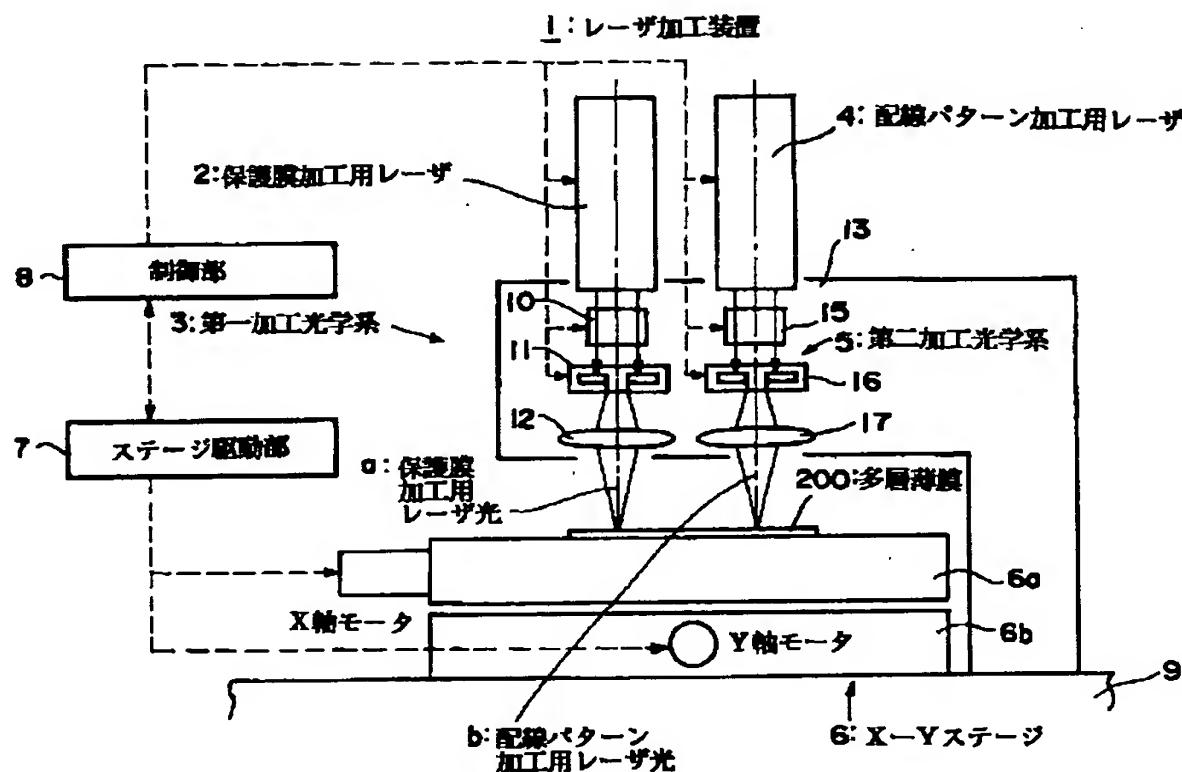
【図3】本発明の第二実施形態に係るレーザ加工装置を示すブロック図である。

【図4】(a)および(b)は従来のレーザ加工方法を説明するために示す断面図である。

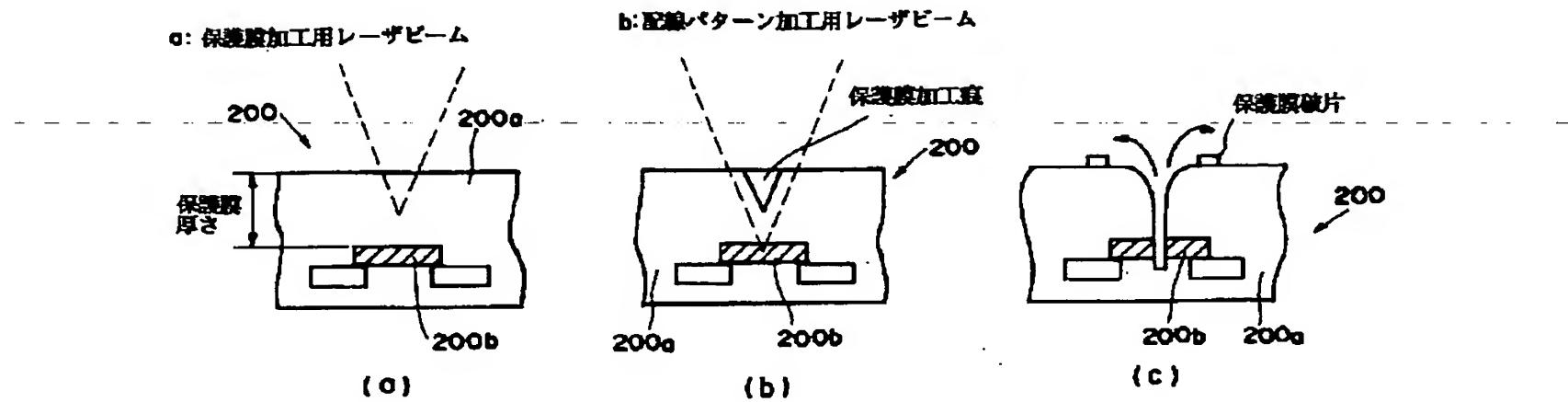
【符号の説明】

- |    |                  |
|----|------------------|
| 10 | 1 レーザ加工装置        |
|    | 2 保護膜加工用レーザ      |
|    | 3 第一加工光学系        |
|    | 4 配線パターン加工用レーザ   |
|    | 5 第二加工光学系        |
|    | 200 多層薄膜         |
|    | 200a 保護膜         |
|    | 200b 配線パターン      |
|    | a 保護膜加工用のレーザ光    |
|    | b 配線パターン加工用のレーザ光 |

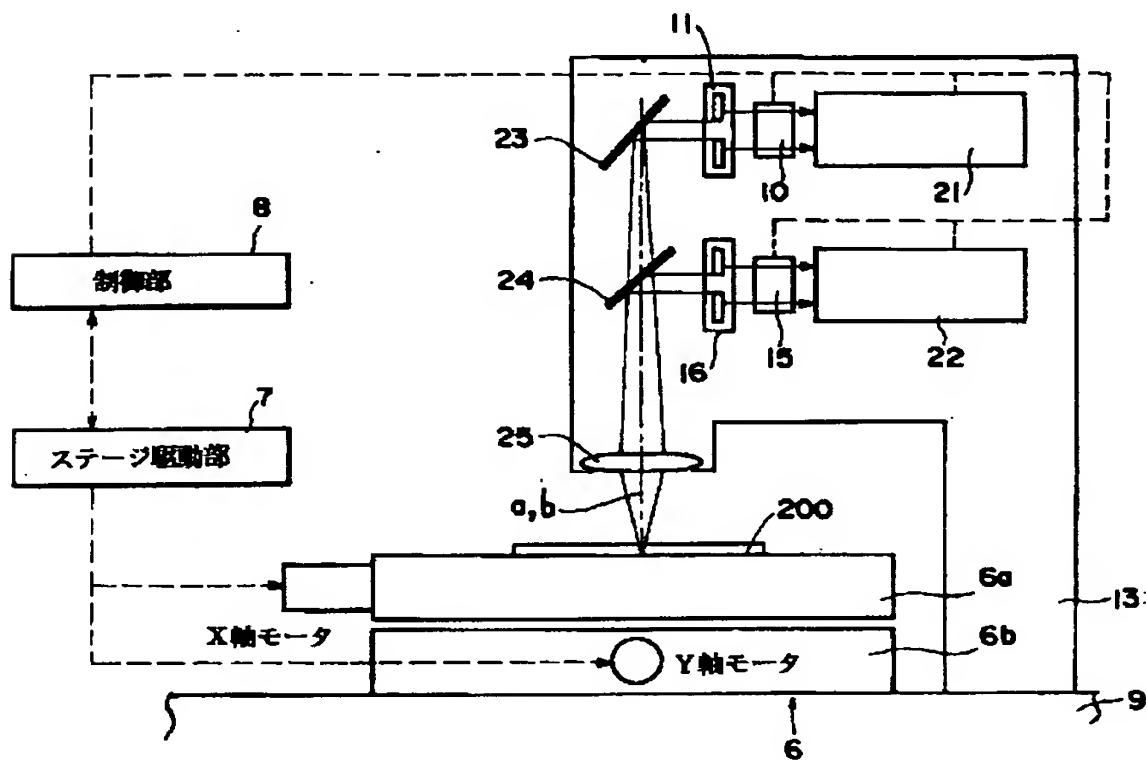
【図1】



【図2】



【図3】



【図4】

